Complete Summary

GUIDELINE TITLE

ACR Appropriateness Criteria® suspected liver metastases.

BIBLIOGRAPHIC SOURCE(S)

Heiken JP, Bree RL, Rosen MP, Foley WD, Gay SB, Grant TH, Huprich JE, Lalani T, Miller FH, Sudakoff GS, Greene FL, Rockey DC, Expert Panel on Gastrointestinal Imaging. ACR Appropriateness Criteria® suspected liver metastasis. [online publication]. Reston (VA): American College of Radiology (ACR); 2008. 8 p. [32 references]

GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: Heiken JP, Bree RL, Foley WD, Gay SB, Glick SN, Huprich JE, Levine MS, Ros PR, Rosen MP, Shuman WP, Greene FL, Expert Panel on Gastrointestinal Imaging. Suspected liver metastases. [online publication]. Reston (VA): American College of Radiology (ACR); 2005. 8 p. [28 references]

The appropriateness criteria are reviewed annually and updated by the panels as needed, depending on introduction of new and highly significant scientific evidence.

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Liver metastases

GUIDELINE CATEGORY

Diagnosis
Evaluation

CLINICAL SPECIALTY

Gastroenterology
Internal Medicine
Nuclear Medicine
Oncology
Radiology

INTENDED USERS

Health Plans
Hospitals
Managed Care Organizations
Physicians
Utilization Management

GUIDELINE OBJECTIVE(S)

To evaluate the appropriateness of initial radiologic examinations for patients suspected liver metastases

TARGET POPULATION

Patients with suspected liver metastases

INTERVENTIONS AND PRACTICES CONSIDERED

1. Computed tomography (CT)
    - Abdominal without contrast
    - Abdominal with contrast
    - Liver arterial portography
2. CT angiography, abdomen
3. Magnetic resonance imaging, abdomen, with and without contrast
4. Ultrasound (US)
    - Abdominal with or without Doppler
    - Intraoperative/laparoscopic abdominal
5. Nuclear medicine (NUC)
    - Indium (In)-111 somatostatin receptor scintigraphy
    - Fluorodeoxyglucose – positron emission tomography (FDG-PET), whole body

MAJOR OUTCOMES CONSIDERED

Utility of radiologic examinations in diagnosis and evaluation of suspected liver metastases

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

The guideline developer performed literature searches of peer-reviewed medical journals, and the major applicable articles were identified and collected.

NUMBER OF SOURCE DOCUMENTS

Not stated

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Not Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not stated

METHODS USED TO ANALYZE THE EVIDENCE

Review of Published Meta-Analyses
Systematic Review with Evidence Tables

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

One or two topic leaders within a panel assume the responsibility of developing an evidence table for each clinical condition, based on analysis of the current literature. These tables serve as a basis for developing a narrative specific to each clinical condition.

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus (Delphi)

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Since data available from existing scientific studies are usually insufficient for meta-analysis, broad-based consensus techniques are needed to reach agreement in the formulation of the appropriateness criteria. The American College of Radiology (ACR) Appropriateness Criteria panels use a modified Delphi technique to arrive at consensus. Serial surveys are conducted by distributing questionnaires to consolidate expert opinions within each panel. These questionnaires are distributed to the participants along with the evidence table and narrative as

developed by the topic leader(s). Questionnaires are completed by the participants in their own professional setting without influence of the other members. Voting is conducted using a scoring system from 1 to 9, indicating the least to the most appropriate imaging examination or therapeutic procedure. The survey results are collected, tabulated in anonymous fashion, and redistributed after each round. A maximum of three rounds is conducted and opinions are unified to the highest degree possible. Eighty percent agreement is considered a consensus. This modified Delphi technique enables individual, unbiased expression, is economical, easy to understand, and relatively simple to conduct.

If consensus cannot be reached by the Delphi technique, the panel is convened and group consensus techniques are utilized. The strengths and weaknesses of each test or procedure are discussed and consensus reached whenever possible. If "No consensus" appears in the rating column, reasons for this decision are added to the comment sections.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

ACR Appropriateness Criteria®

Clinical Condition: Suspected Liver Metastases

Variant 1: Initial imaging test following detection of primary tumor.

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen with contrast	8	Images are acquired during PVP. HAP imaging is useful for patients with a	Med

Radiologic Procedure	Rating	Comments	RRL*
		hypervascular primary tumor such as (but not limited to) renal cell, pancreatic islet cell, and thyroid carcinoma; carcinoid and other neuroendocrine tumors; and melanoma.	
MRI abdomen with contrast	7	Dynamic gadolinium-chelate-enhanced imaging is used most commonly. Delayed imaging after SPIO or gadolinium-BOPTA-enhanced imaging can be useful for staging patients with liver metastases. See comments regarding contrast in the text below under "Anticipated Exceptions."	None
FDG-PET whole body	6		High
CT abdomen without contrast	4		Med
MRI abdomen without contrast	4		None
US abdomen with or without Doppler	4		None
CT arterial portography liver	2		Med
CTA abdomen	2		Med
NUC In-111 somatostatin receptor scintigraphy	2	May be useful in patients with neuroendocrine tumors.	High
Rating Scale: 1=Least appropriate, 9=Most appropriate			***Relative Radiation Level**

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 2: Surveillance following treatment of primary tumor.

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen with contrast	8	Images are acquired during PVP. HAP imaging is useful for patients with a hypervascular primary tumor such as (but not limited to) renal cell, pancreatic islet cell, and thyroid carcinoma; carcinoid and other neuroendocrine tumors; and melanoma.	Med
MRI abdomen with contrast	7	Dynamic gadolinium-chelate-enhanced imaging is used most commonly. Delayed imaging after SPIO or gadolinium-BOPTA-enhanced imaging can be useful for staging patients with liver metastases. See comments regarding contrast in the text below under "Anticipated Exceptions."	None
FDG-PET whole body	6		High
CT abdomen without contrast	4		Med
MRI abdomen without contrast	4		None
US abdomen with or without Doppler	4		None
NUC In-111 somatostatin receptor scintigraphy	4	May be useful in patients with neuroendocrine tumors.	High
CT arterial portography liver	2		Med
CTA abdomen	2		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			***Relative Radiation Level**

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 3: Abnormal surveillance US, CT, or MRI in PVP: high suspicion of malignancy.

Radiologic Procedure	Rating	Comments	RRL*
INV percutaneous biopsy liver	8		IP
CT abdomen with contrast	8	Images are acquired during PVP. HAP imaging is useful for patients with a hypervascular primary tumor such as (but not limited to) renal cell, pancreatic islet cell, and thyroid carcinoma; carcinoid and other neuroendocrine tumors; and melanoma.	Med
MRI abdomen with contrast	8	Dynamic gadolinium-chelate-enhanced imaging is used most commonly. Delayed imaging after SPIO or gadolinium-BOPTA-enhanced imaging can be useful for staging patients with liver metastases. See comments regarding contrast in the text below under "Anticipated Exceptions."	None
FDG-PET whole body	8		High
MRI abdomen without contrast	4		None
US abdomen with or without Doppler	4		None
US abdomen intraoperative/laparoscopic	4		None
NUC In-111 somatostatin receptor scintigraphy	3	May be useful in patients with neuroendocrine tumors.	High
CT arterial portography liver	3		Med
CTA abdomen	3		Med
CTA abdomen without contrast	2		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			***Relative Radiation Level**

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 4: Abnormal surveillance US, CT, or MRI in PVP: high suspicion of benignancy.

Radiologic Procedure	Rating	Comments	RRL*
MRI abdomen with contrast	8	Dynamic gadolinium-chelate-enhanced imaging is used most commonly. Delayed imaging after SPIO or gadolinium-BOPTA-enhanced imaging can be useful for staging patients with liver metastases. See comments regarding contrast in the text below under "Anticipated Exceptions."	None
CT abdomen with contrast	8	Images are acquired during PVP. HAP imaging is useful for patients with a hypervascular primary tumor such as (but not limited to) renal cell, pancreatic islet cell, and thyroid carcinoma; carcinoid and other neuroendocrine tumors; and melanoma.	Med
MRI abdomen without contrast	5		None
INV percutaneous biopsy liver	4		IP
US abdomen with or without Doppler	4		None
NUC In-111 somatostatin receptor scintigraphy	3	May be useful in patients with neuroendocrine tumors.	High
CT arterial portography liver	3		Med
CTA abdomen	3		Med
US abdomen intraoperative/laparoscopic	3		None
FDG-PET whole body	2		High
CT abdomen without contrast	2		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			***Relative Radiation Level**

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Summary of Literature Review

In the United States, metastatic disease is the most common cause of malignancy in the liver and is 20 to 50 times more common than primary liver cancer. The colon, stomach, pancreas, and breast are the most common primary sites. The appearance of a new lesion in the liver in a patient with a history of cancer strongly suggests hepatic metastasis. On the other hand, most small (1-1.5 cm) liver lesions, even in patients with known malignancy, are not malignant, especially if there are fewer than five lesions. In most series, about one-third of patients who die with a malignancy have liver involvement.

The liver is susceptible to metastatic disease primarily due to the nature of the endothelial lining. The dual blood supply to the liver has an effect on the vascularity of liver metastases, with those supplied by the hepatic arterial system being more vascular than those supplied by the portal venous system. Most gastrointestinal cancer is spread through the portal venous system, whereas other tumors are spread through the hepatic arterial system. Numerous imaging methods are available for detecting intrahepatic metastatic disease before, during, and after definitive therapy for the primary lesion. The usefulness of various imaging tests can vary significantly across institutions because of local radiological expertise, availability of equipment or personnel, and the wishes and biases of treating physicians and radiologists.

This document will review the broad variety of available imaging tests so that each can be rated by the consensus panel, realizing that many published scientific studies do not compare all imaging tests at the current state of the art.

Ultrasound

Ultrasound (US) is the most available technique for liver imaging worldwide, and in many countries is the major imaging test used to search for liver metastases. In the United States, the relative availability of computed tomography (CT) and magnetic resonance imaging (MRI), limited physician involvement in the performance of US, and the lack of availability of US contrast agents contribute to a lesser role for US diagnosis. In the United States pretreatment and post-treatment screening for metastases is performed infrequently with US. Comparative studies demonstrate that unenhanced grey-scale US has high specificity but lower sensitivity than CT and MRI. With US, metastases can be hypoechoic, hyperechoic, cystic, or diffuse. Doppler may be useful, particularly in vascular lesions such as neuroendocrine tumors, sarcomas and lymphomas.

Intraoperative/Laparoscopic Ultrasound

Intraoperative ultrasound (IOUS) is the most accurate imaging technique for detecting liver metastases at the time of primary tumor resection or resection of previously identified hepatic metastases. It is complementary to surgical inspection and palpation. Additionally, IOUS can be important for localization of tumors for ablative techniques or to guide intraoperative biopsy or surgical resection.

Laparoscopic US (LUS), an alternative to open IOUS has shown promising results. In one study of 55 patients with primary and secondary liver neoplasms who underwent LUS as part of a tumor ablation procedure, LUS demonstrated all 201 liver tumors shown by triphasic CT and an additional 21 lesions not shown by CT.

Computed Tomography

CT is particularly suited for the evaluation of metastatic disease, because the liver and potential extra-hepatic sites of tumor spread can be evaluated during the same examination. Multidetector helical CT (MDCT) is the preferred examination in the United States for surveillance for metastatic disease after treatment of the primary neoplasm. Because most hepatic metastases are relatively hypovascular compared with normal liver parenchyma, the lesions are hypoattenuating when imaged during the peak of hepatic parenchymal enhancement (portal venous phase). In general, therefore, imaging during the portal venous phase of hepatic enhancement is adequate to detect most hepatic lesions in most patients.

Hypervascular lesions are less common, and tumors in this group include metastases from renal cell carcinoma, carcinoid, islet cell carcinoma, thyroid carcinoma, melanoma, and neuroendocrine tumors. In a large series of patients, small (<2 cm) hypervascular lesions were seen better in the arterial phase than in the portal venous phase. With the widespread use of multidetector-row scanners, arterial phase scanning can be routine. Although metastases from breast carcinoma are sometimes hypervascular, two studies showed that arterial phase imaging was not necessary in this group. Hypervascular lesions may be isoattenuating to liver during the portal venous phase of hepatic enhancement. With helical CT, both arterial and portal venous phase imaging is recommended for patients with hypervascular primary tumors. If helical CT is not available, a noncontrast scan can also be useful.

CT arterial portography is no longer used extensively, as it is an invasive angiographic technique that often yields confusing artifacts that decreases accuracy. Newer arterial mapping techniques using MR and CT angiography have largely replaced standard angiographic techniques for preoperative staging.

Magnetic Resonance Imaging

With MRI, most hepatic metastases are hypointense to normal liver on T1-weighted images and hyperintense to liver on T2-weighted images. Morphologic, signal intensity, and contrast enhancement features have been shown to be useful in distinguishing metastatic lesions from common benign lesions such as hemangiomas and cysts.

Contrast-enhanced imaging is an important part of the hepatic MRI examination for detection of metastases and is particularly useful in characterizing hepatic lesions that are identified. Gadolinium chelates, which are the most widely used MR contrast agents, are most useful when used with dynamic T1-weighted gradient echo sequences. Gadolinium-enhanced MRI and dynamic contrast-enhanced CT are comparable in their ability to identify patients with hepatic metastases. Most comparative studies, however, have shown MRI to be somewhat more sensitive than contrast-enhanced CT for detecting individual hepatic metastases, although comparative studies using state-of-the-art MDCT scanners

are lacking. MRI using superparamagnetic iron oxide (SPIO) contrast agents, which are taken up selectively by the reticuloendothelial system, has been shown to be more sensitive than unenhanced MRI and equal to or more sensitive than gadolinium-enhanced MRI. In one study SPIO-enhanced MRI also was more sensitive than 16-row MDCT for detecting liver metastases. Delayed phase imaging during gadobenate dimeglumine (GD-BOPTA)-enhanced MRI and mangafodipir trisodium (Mn-DPDP)-enhanced MRI have been shown to be equivalent to SPIO-enhanced MRI for detecting liver metastases, but mangafodipir currently is not available in the United States.

Nuclear Imaging

Positron emission tomography (PET) has become more widely used in detecting metastatic disease. Two meta-analyses comparing CT, MRI, and 18F fluorodeoxyglucose (FDG) PET in patients with cancers of the gastrointestinal tract concluded that FDG-PET is the most sensitive imaging test for the diagnosis of hepatic metastases from colorectal cancer. In addition, several studies have demonstrated that the addition of FDG-PET to a conventional staging evaluation in colorectal cancer patients with potentially resectable liver metastases results in a change in management of 20% to 32%, mainly due to detection of unknown extrahepatic disease. PET also has been shown to be accurate in distinguishing benign from malignant liver tumors. A limitation of FDG-PET, however, is that it may fail to demonstrate small (<1 cm) liver metastases. In addition, the sensitivity of FDG-PET for demonstrating hepatic metastases from colorectal cancer is reduced in patients who have undergone recent chemotherapy. For staging and restaging patients with colorectal liver metastases, integration of CT and FDG-PET data, either by fusion or by integrated PET-CT imaging, enables better management guidance than with either technique alone.

Traditional reticulo-endothelial radionuclide imaging is no longer used for detecting liver metastases. Somatostatin receptor scintigraphy is capable of demonstrating hepatic metastases from endocrine tumors but is not as sensitive as CT and MRI.

Summary

Many radiologic techniques are available for preoperative detection of liver metastases and postoperative surveillance. Some of the less widely used screening techniques can be useful when there is a need for specific problem solving. Rapid technological and clinical advances in equipment, contrast agents, and radioisotopes make direct comparison of the various techniques difficult. In addition, local custom and equipment availability within communities or medical centers can be expected to lead to a variety of indications and applications in detecting of hepatic metastatic disease.

Anticipated Exceptions

Nephrogenic systemic fibrosis (NSF, also known as nephrogenic fibrosing dermopathy) was first identified in 1997 and has recently generated substantial concern among radiologists, referring doctors and lay people. Until the last few years, gadolinium-based MR contrast agents were widely believed to be almost universally well tolerated, extremely safe and non-nephrotoxic, even when used in

patients with impaired renal function. All available experience suggests that these agents remain generally very safe, but recently some patients with renal failure who have been exposed to gadolinium contrast agents (the percentage is unclear) have developed NSF, a syndrome that can be fatal. Further studies are necessary to determine what the exact relationships are between gadolinium-containing contrast agents, their specific components and stoichiometry, patient renal function and NSF. Current theory links the development of NSF to the administration of relatively high doses (e.g., >0.2mM/kg) and to agents in which the gadolinium is least strongly chelated. The U.S. Food and Drug Administration (FDA) has recently issued a "black box" warning concerning these contrast agents (http://www.fda.gov/cder/drug/InfoSheets/HCP/gcca_200705HCP.pdf).

This warning recommends that, until further information is available, gadolinium contrast agents should not be administered to patients with either acute or significant chronic kidney disease (estimated glomerular filtration rate [GFR] <30 mL/min/1.73m^2), recent liver or kidney transplant or hepato-renal syndrome, unless a risk-benefit assessment suggests that the benefit of administration in the particular patient clearly outweighs the potential risk(s).

Abbreviations

- CT, computed tomography
- CTA, computed tomography angiography
- FDG-PET, fluorodeoxyglucose – positron emission tomography
- BOPTA, gadobenate dimeglumine
- HAP, hepatic arterial phase
- In, indium
- INV, invasive
- IP, in progress
- Med, medium
- MRI, magnetic resonance imaging
- NUC, nuclear medicine
- PVP, portal venous phase
- SPIO, superparamagnetic iron oxide
- US, ultrasound

Relative Radiation Level*	Effective Dose Estimated Range
None	0
Minimal	<0.1 mSv
Low	0.1-1 mSv
Medium	1-10 mSv
High	10-100 mSv
*RRL assignments are not included for some examinations. The RRL assignments for the IP (in progress) exams will be available in future releases.	

CLINICAL ALGORITHM(S)

None provided

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The recommendations are based on analysis of the current literature and expert panel consensus.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

Selection of appropriate radiologic imaging procedures for evaluation of patients suspected of liver metastases

POTENTIAL HARMS

Recently some patients with renal failure who have been exposed to gadolinium contrast agents (the percentage is unclear) have developed nephrogenic systemic fibrosis (NSF), a syndrome that can be fatal. The U.S. Food and Drug Administration (FDA) has recently issued a "black box" warning concerning these contrast agents. This warning recommends that, until further information is available, gadolinium contrast agents should not be administered to patients with either acute or significant chronic kidney disease (estimated glomerular filtration rate [GFR] <30 mL/min/1.73m^2), recent liver or kidney transplant or hepato-renal syndrome, unless a risk-benefit assessment suggests that the benefit of administration in the particular patient clearly outweighs the potential risk(s).

Relative Radiation Level (RRL)

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Additional information regarding radiation dose assessment for imaging examinations can be found in the American College of Radiology (ACR) Appropriateness Criteria® Radiation Dose Assessment Introduction document (see "Availability of Companion Documents" field).

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

An American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring

physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

IMPLEMENTATION TOOLS

Personal Digital Assistant (PDA) Downloads

For information about availability, see the "Availability of Companion Documents" and "Patient Resources" fields below.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better
Living with Illness

IOM DOMAIN

Effectiveness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

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ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

1998 (revised 2008)

GUIDELINE DEVELOPER(S)

American College of Radiology - Medical Specialty Society

SOURCE(S) OF FUNDING

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria®.

GUIDELINE COMMITTEE

Committee on Appropriateness Criteria, Expert Panel on Gastrointestinal Imaging

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Panel Members: Jay P. Heiken, MD; Robert L. Bree, MD, MHSA; Max Paul Rosen, MD, MPH; W. Dennis Foley, MD; Spencer B. Gay, MD; Thomas H. Grant, DO; James E. Huprich, MD; Tasneem Lalani, MD; Frank H. Miller, MD; Gary S. Sudakoff, MD; Frederick L. Greene, MD; Don C. Rockey, MD

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

GUIDELINE STATUS

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The appropriateness criteria are reviewed annually and updated by the panels as needed, depending on introduction of new and highly significant scientific evidence.

GUIDELINE AVAILABILITY

Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.

ACR Appropriateness Criteria® *Anytime*, *Anywhere*™ (PDA application). Available from the ACR Web site.

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

AVAILABILITY OF COMPANION DOCUMENTS

The following are available:

- ACR Appropriateness Criteria®. Background and development. Reston (VA): American College of Radiology; 2 p. Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.
- ACR Appropriateness Criteria® radiation dose assessment introduction. American College of Radiology. 2 p. Electronic copies: Available from the American College of Radiology Web site.

PATIENT RESOURCES

None available

NGC STATUS

This summary was completed by ECRI on March 19, 2001. The information was verified by the guideline developer on March 29, 2001. This NGC summary was updated by ECRI on January 26, 2006. This summary was updated by ECRI Institute on May 17, 2007 following the U.S. Food and Drug Administration (FDA) advisory on Gadolinium-based contrast agents. This summary was updated by ECRI Institute on June 20, 2007 following the U.S. Food and Drug Administration (FDA) advisory on gadolinium-based contrast agents. This summary was updated by ECRI Institute on June 23, 2009.

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